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Appl. No. 10/613,598
Amdt. dated 01/10/2005
Reply to Office action of 12/07/2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1.(currently amended) A method to enhance stability of a free layer, while retaining free layer signal strength, in a magnetic read head, comprising:

providing a pair of opposing permanent magnet layers separated by a first gap and magnetized in a first direction, that abut, and thereby provide longitudinal bias to, said free layer;

forming, at a distance above said permanent magnet layers, a pair of opposing additional bias layers that are separated by a second gap that is less than or equal to said first gap; and

then magnetizing said additional bias layers in a second direction that is antiparallel to said first direction.

2.(original) The method of claim 1 wherein said additional bias layer is selected from the group consisting of CoPt, CoCrPt, CoNiCr, NiFe/IrMn, and CoFe/IrMn whereby it has good exchange coupling field with antiferromagnetic layers, giving it an effective coercivity that is between about 0.05 and 0.75 times that of said permanent magnet layer.

3.(original) The method of claim 1 wherein said additional bias layer is deposited to a thickness that is at most 0.02 microns less than that of said permanent magnet layer.

Appl. No. 10/613,598
Amdt. dated 01/10/2005
Reply to Office action of 12/07/2004

- 4.(original) The method of claim 1 wherein said first gap is between about 0.1 and 0.2 microns and said second gap is between about 0.08 and 0.2 microns.
- 5.(original) The method of claim 1 wherein said distance above said permanent magnet layer of the opposing additional bias layer is between about 50 and 300 Angstroms.
- 6.(original) The method of claim 1 wherein said magnetic read head is a CIP GMR head.
- 7.(original) The method of claim 1 wherein said magnetic read head is a CPP GMR head.
- 8.(original) The method of claim 1 wherein said magnetic read head is a TMR head.
- 9.(currently amended) A method to enhance stability of a free layer, while retaining free layer signal strength, in a magnetic read head, comprising:
 providing a pair of opposing permanent magnet layers, separated by a first gap and magnetized in a first direction, that abut, and thereby provide longitudinal bias to, said free layer;
 inserting, below said permanent magnet layers, a pair of opposing additional bias layers that are separated by a second gap that is less than or equal to said first gap; and
 then magnetizing said additional bias layer in a second direction that is antiparallel to said first direction.
- 10.(original) The method of claim 9 wherein said magnetic read head is a CIP GMR head.

Appl. No. 10/613,598

Amdt. dated 01/10/2005

Reply to Office action of 12/07/2004

11.(original) The method of claim 9 wherein said magnetic read head is a CPP GMR head.

12.(original) The method of claim 9 wherein said magnetic read head is a TMR head.

13.(original) The method of claim 9 wherein said additional bias layer is selected from the group consisting of CoPt, CoCrPt, CoNiCr, NiFe/IrMn, and CoFe/IrMn whereby it has good exchange coupling field with antiferromagnetic layers, giving it an effective coercivity that is between about 0.05 and 0.75 times that of said permanent magnet layer.

14.(original) The method of claim 9 wherein said additional bias layer is deposited to a thickness that is at most 0.02 microns less than that of said permanent magnet layer.

15.(original) The method of claim 9 wherein said first gap is between about 0.1 and 0.2 microns and said second gap is between about 0.08 and 0.2 microns.

16.(original) The method of claim 9 wherein said distance below said permanent magnet layer of the opposing additional bias layer is between about 50 and 300 Angstroms.

17.(currently amended) A magnetic read head having a free layer with enhanced stability and signal strength, comprising:

a pair of opposing permanent magnet layers, separated by a first gap and magnetized in a first direction, that abut, and thereby provide longitudinal bias to, the free layer;

above said permanent magnet layers, a pair of opposing additional bias layers

Appl. No. 10/613,598
Amdt. dated 01/10/2005
Reply to Office action of 12/07/2004

that are separated by a second gap that is less than or equal to said first gap; and
said additional bias layers being magnetized in a second direction that is
antiparallel to said first direction.

18.(original) The magnetic read head described in claim 17 is a CIP GMR head.

19.(original) The magnetic read head described in claim 17 is a CPP GMR head.

20.(original) The magnetic read head described in claim 17 is a TMR head.

21.(original) The magnetic read head described in claim 17 wherein said additional
bias layer is selected from the group consisting of CoPt, CoCrPt, CoNiCr, NiFe/IrMn,
and CoFe/IrMn whereby it has good exchange coupling field with antiferromagnetic
layers, giving it an effective coercivity that is between about 0.05 and 0.75 times that of
said permanent magnet layer.

22.(original) The magnetic read head described in claim 17 wherein said additional
bias layer has a thickness that is at most 0.02 microns less than that of said permanent
magnet layer.

23.(original) The magnetic read head described in claim 17 wherein said first gap is
between about 0.1 and 0.2 microns and said second gap is between about 0.08 and
0.2 microns.

24.(original) The magnetic read head described in claim 17 wherein said distance
above said permanent magnet layer of the opposing additional bias layer is between
about 50 and 300 Angstroms.

Appl. No. 10/613,598

Amdt. dated 01/10/2005

Reply to Office action of 12/07/2004

25.(currently amended) A magnetic read head having a free layer with enhanced stability and signal strength, comprising:

a pair of opposing permanent magnet layers, separated by a first gap and magnetized in a first direction, that abut, and thereby provide longitudinal bias to, the free layer;

a distance below said permanent magnet layers, a pair of opposing additional bias layers that are separated by a second gap that is less than or equal to said first gap; and

said additional bias layer being magnetized in a second direction that is antiparallel to said first direction.

26.(original) The magnetic read head described in claim 25 is a CIP GMR head.

27.(original) The magnetic read head described in claim 25 is a CPP GMR head.

28.(original) The magnetic read head described in claim 25 is a TMR head.

29.(original) The magnetic read head described in claim 25 wherein said additional bias layer is selected from the group consisting of CoPt, CoCrPt, CoNiCr, NiFe/IrMn, and CoFe/IrMn whereby it has good exchange coupling field with antiferromagnetic layers, giving it an effective coercivity that is between about 0.05 and 0.75 times that of said permanent magnet layer.

30.(original) The magnetic read head described in claim 25 wherein said additional bias layer has a thickness that is at most 0.02 microns less than that of said permanent magnet layer.

Appl. No. 10/613,598

Amdt. dated 01/10/2005

Reply to Office action of 12/07/2004

31.(original) The magnetic read head described in claim 25 wherein said first gap is between about 0.1 and 0.2 microns and said second gap is between about 0.08 and 0.2 microns.

32.(original) The magnetic read head described in claim 25 wherein said distance below said permanent magnet layer of the opposing additional bias layer is between about 50 and 300 Angstroms.